

**JOINT LEGISLATIVE AUDIT AND REVIEW COMMISSION
OF THE VIRGINIA GENERAL ASSEMBLY**

TECHNICAL APPENDIX

**Analysis of the Need,
Costs, and Funding for
Parallel Tunnels**

**The Future of the
Chesapeake Bay
Bridge-Tunnel**

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Analysis of the Need, Costs, and Funding for Parallel Tunnels

The study of the future of the Chesapeake Bay Bridge-Tunnel, required by HJR 210 (2002), found that new tunnels parallel to the existing tunnels may be needed by the year 2020. This finding is based on an analysis of projected future traffic, and the potential for increases in traffic to impact service levels on the facility. Analysis for the study also found that the district which operates the facility will likely have insufficient funds to complete construction of the new tunnels by 2020. This technical appendix explains the use of projected traffic to evaluate the need for the parallel tunnels and the estimation of future funding available for such a project.

The JLARC staff analysis of the need, costs, and funding of parallel tunnels for the Chesapeake Bay Bridge-Tunnel was based on the underlying assumption that the need for construction of parallel tunnels should be driven primarily by increases in traffic volume, which would necessitate an increase in tunnel capacity. Other factors which might point to the need for parallel tunnels, such as safety or the need for increased channel depths were secondary.

The analysis had six parts: (1) projection of monthly traffic counts through the year 2025, (2) evaluation of the monthly traffic projections based on service criteria, (3) evaluation of secondary need factors such as safety, (4) projection of estimated engineering and construction costs through 2025, (5) projection of estimated cash balances and bonding capacity through 2025 for the current toll structure, and (6) evaluation of costs, available funding, and certain potential modifications of the toll structure. The analysis for each step is described below.

Traffic Projections

The traffic projections produced for the study were based on a series of regression models and other estimation techniques. Among the key assumptions in the projection of monthly traffic were:

- traffic growth over the next 23 years will approximate the historical trend, with periodic downturns due to cycles in the U.S. economy;
- vehicle classes and toll rates will remain constant over the next 23 years;
- there will be no significant changes in the U.S. or Virginia economies;
- there will be no significant changes in the operation and maintenance of the Chesapeake Bay Bridge-Tunnel and no extended closures of the facility; and
- there will be no significant changes in the national transportation infrastructure.

The regression models provided an explanation for the seasonal and long-term trends in the observed traffic data. Once the historical relationships among the economic, demographic, and traffic variables were measured by the regression models, they could be used to project future traffic volumes. Regression models were used to

project the traffic for seven of 16 vehicle classes or subclasses. The independent variables included the motor fuels CPI, local and regional employment, regional and local population, total U.S. employment, real U.S. personal income, Virginia total employment, and Virginia population. Not every independent variable was used in each model. A summary of each of the seven regression models is included as Attachment A.

For vehicle classes in which a regression model could not be used, the mean trend for the most recent period was used. Table 1 identifies the projection method used for each vehicle class or subclass. The table also identifies the regression model used. For vehicle classes projected using a non-regression method, the actual annual value used is also shown in Table 1.

Table 1
Projection Methods for Chesapeake Bay Bridge-Tunnel Traffic

Vehicle Class	Projection Method	Actual Value
Class 1	Regression Model (CARS_02)	n/a
Class 65	Fraction of Class 1 vehicles	~ 14.9%
Class 2	Regression Model (CARS_3)	n/a
Class 3	Mean of last 10 years: 1992:06 – 2002:06	17,676
Class 4	Mean of last 10 years: 1992:06 – 2002:06	276
Class 8	Mean of last 21 months: 2000:10 – 2002:06	1,104
Class 9	Regression Model (TRUCK_2)	n/a
Class 10	Regression Model (TRUCK_3)	n/a
Class 11	Regression Model (TRUCK_4)	n/a
Class 12	Regression Model (TRUCK_5)	n/a
Class 13	Mean of last 150 months: 1990:01 – 2002:06	2,832
Class 14	Mean of last 21 months: 2000:10 – 2002:06	576
Class 15	Regression Model (BUS_3)	n/a
Class 16	Mean of last 38 months: 1999:04 – 2002:06	420
Class 16E	Mean of last 38 months: 1999:04 – 2002:06	444
Non-revenue	Annual Average from 1999 to 2002	85,044

Source: JLARC staff analysis of economic and traffic data.

In the past, CBBT traffic has responded negatively to recessions, with slower rates of growth or actual reductions in traffic counts compared to the same period for prior years. Over the last 25 years or so, there has been a recession at least once a decade. The National Bureau of Economic Research (NBER), a non profit organization provides a widely used method of dating recessions. Based on NBER data, there were recessions starting in 1973, 1980, 1981, 1990 and 2001. To account for the impact of recessionary periods on CBBT traffic volume, JLARC staff traffic projections include two simulated recessions, designed to have an impact that is proportional to the effects of the 1990 recession.

To simulate the two recessions, JLARC staff adjusted the projected economic data used in the traffic estimation spreadsheets. Each simulated recession was assumed to last nine months, as did the 1990 recession. Each economic variable, which was previously projected out to 2025 based on historic trend growth, was re-

duced for the nine months of the recession. For each economic variable, JLARC staff calculated the monthly average percent change in the 12 months prior to the 1990 recession. Next, the monthly average percent change during the recession was calculated for the same variable. Then, the proportional difference between the pre-recessionary and recessionary periods was calculated. This percentage decrease in trend growth was used to lower the nine month period for each recession for the variable in question. The result is a level shift in the rate of growth over the period for the nine months of the simulated recession. Since past recessions have occurred about once in each decade, JLARC staff began the first simulated recession in January of 2012 and the second in January of 2024.

The results of the traffic projections are shown in Figure 1 and Table 2. Figure 1 shows the actual growth in annual traffic from 1965 through 2002, as well as the projected annual traffic from 2003 through 2025. It also shows the recessions since 1965 (gray bars), for reference to CBBT traffic volume growth. Table 2 shows the projected traffic counts for each month from 2003 to 2025. These monthly traffic volumes were used to evaluate the potential change in service levels over the 23-year period of the analysis.

Figure 2 shows a graph of projected monthly traffic from the models. The figure also shows the performance of the projections in comparison to actual monthly traffic for the period from January 1990 through January 2002. The error in the projections – that is, the difference between the actual and projected values – is plotted at the bottom of the figure, and displays the desired pattern of random noise in the data rather than systematic error in the models.

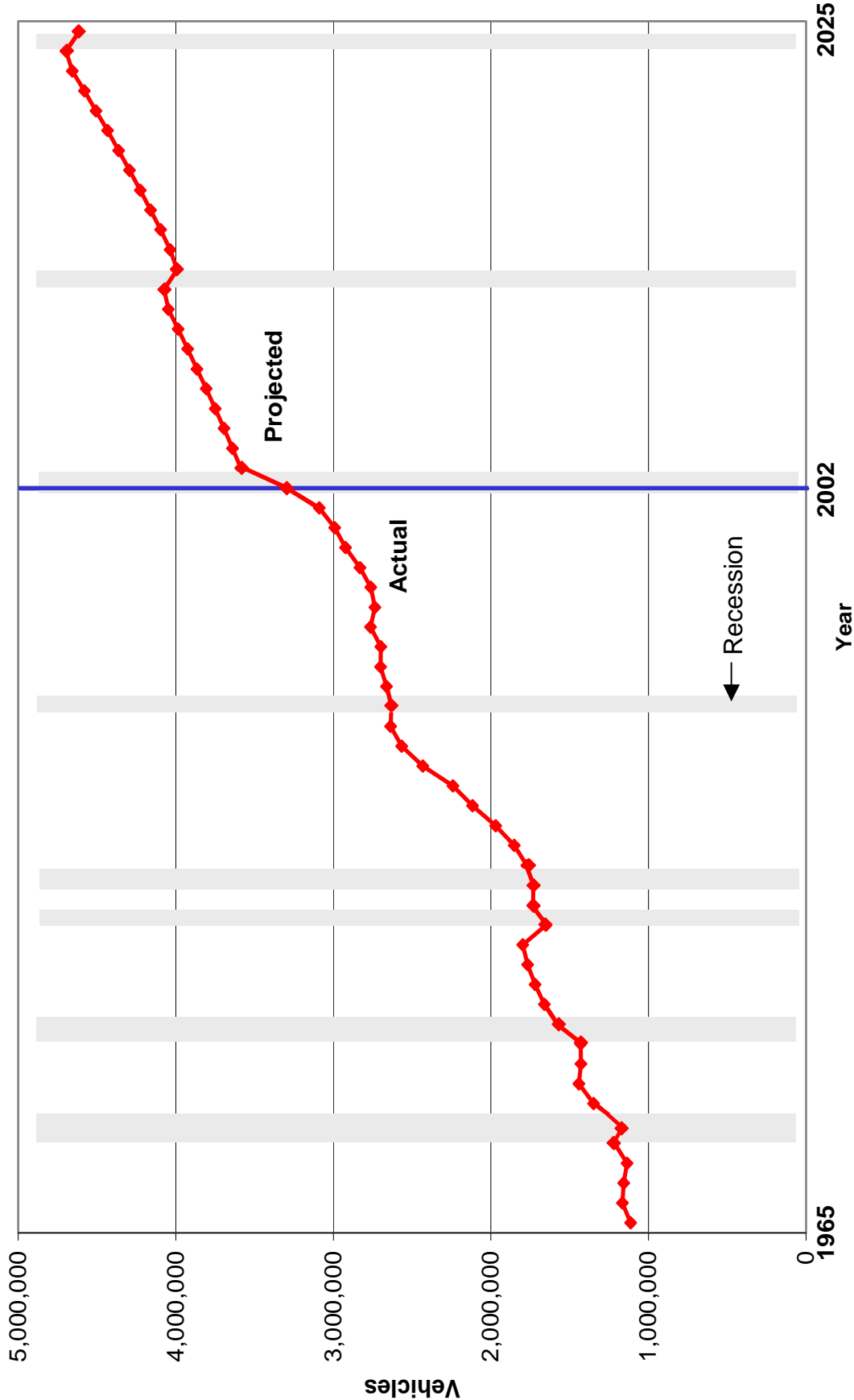
Evaluation of Monthly Traffic Based on Service Criteria

Once the monthly traffic for future periods is known, it is possible to evaluate when the level of traffic might result in the need for additional capacity to ensure a desired level of service. Key assumptions for the assessment of service criteria using projected traffic were:

- the need for parallel tunnels will be based on the need to increase capacity to move traffic, with other factors as secondary considerations;
- the \$10 toll imposes a higher expectation for appropriate capacity to ensure safe traffic flow at the posted speed limit, except in circumstances beyond the control of the Bridge-Tunnel district;
- the existing tunnels are similar to Class I, two lane rural highways with regard to service levels;
- the tunnel four (4) percent grades are approximated by “rolling terrain” in evaluating service levels, as outlined in the Highway Capacity Manual; and
- service levels are based on the posted speed limit of 55 mph.

The basic criterion for defining need based on traffic was the point in time at which the current monthly peak traffic volume would be reached in six or more months per year. Since current traffic volumes in peak months might already exceed desired service levels, the base level of traffic in each of the service levels as

Figure 1
Actual and Projected Annual Traffic



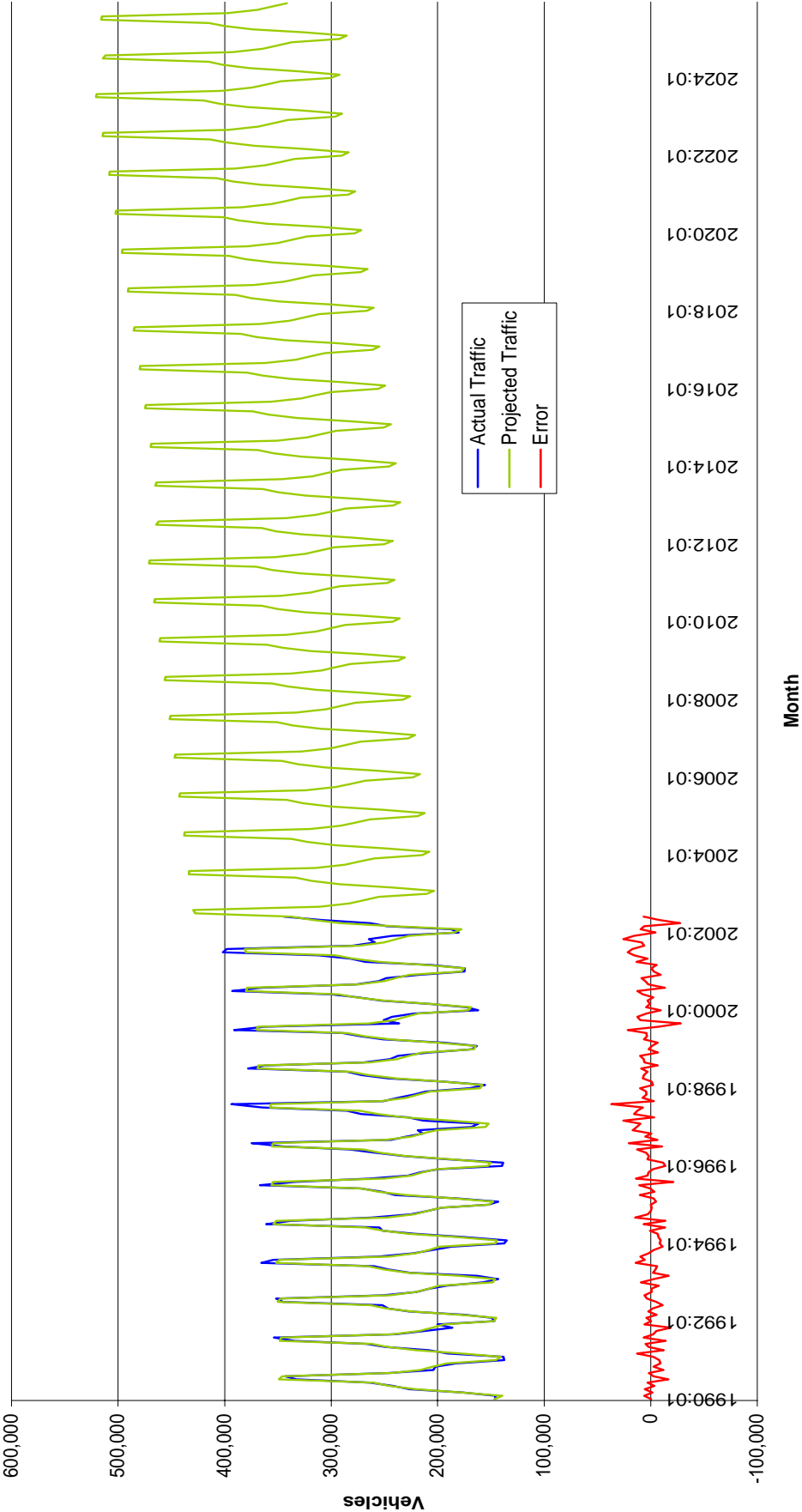
Source: JLARC staff models of economic and traffic data.

Table 2
Projected Monthly Traffic
2003 -- 2025

Year	January	February	March	April	May	June	July	August	September	October	November	December
2003	210,187	203,529	243,003	292,139	318,219	333,470	433,443	433,116	315,167	286,804	273,117	259,116
2004	214,494	207,886	247,126	296,325	322,332	337,261	437,965	437,327	319,508	291,109	277,440	263,443
2005	218,869	212,269	251,496	300,711	326,716	341,634	442,394	441,731	323,936	295,539	281,881	267,892
2006	223,332	216,741	255,974	305,198	331,210	346,133	446,905	446,246	328,462	300,073	286,423	272,443
2007	227,893	221,310	260,552	309,784	335,805	350,736	451,516	450,866	333,091	304,710	291,069	277,098
2008	232,557	225,983	265,233	314,474	340,503	355,443	456,232	455,591	337,825	309,453	295,821	281,859
2009	237,327	230,762	270,021	319,271	345,310	360,258	461,057	460,425	342,668	314,305	300,683	286,729
2010	242,207	235,651	274,919	324,178	350,226	365,184	465,992	465,370	347,622	319,269	305,656	291,712
2011	247,199	240,652	279,931	329,199	355,257	370,225	471,042	470,429	352,691	324,347	310,744	296,810
2012	250,294	242,161	279,753	327,356	351,742	365,040	464,188	461,908	342,505	314,400	300,646	286,659
2013	241,934	235,243	274,360	323,478	349,387	364,210	464,884	464,132	346,256	317,922	304,277	290,320
2014	245,775	239,204	278,457	327,702	353,737	368,683	469,479	468,847	351,089	322,742	309,130	295,191
2015	250,680	244,136	283,417	332,690	358,751	373,723	474,545	473,938	356,205	327,869	314,274	300,348
2016	255,853	249,324	288,620	337,907	363,983	378,970	479,806	479,213	361,494	333,170	319,587	305,673
2017	261,191	254,674	293,983	343,282	369,370	384,369	485,217	484,635	366,928	338,616	325,045	311,142
2018	266,671	260,166	299,486	348,797	374,897	389,907	490,767	490,196	372,501	344,200	330,640	316,749
2019	272,289	265,796	305,128	354,450	380,561	395,583	496,454	495,896	378,212	349,923	336,375	322,495
2020	278,047	271,566	310,909	360,243	386,366	401,400	502,283	501,736	384,064	355,787	342,250	328,383
2021	283,947	277,477	316,833	366,179	392,314	407,359	508,255	507,720	390,060	361,795	348,271	334,415
2022	289,992	283,535	322,902	372,260	398,408	413,466	514,374	513,851	396,204	367,951	354,440	340,597
2023	296,186	289,741	329,121	378,492	404,652	419,723	520,643	520,134	402,499	374,260	360,761	346,931
2024	300,383	292,245	329,821	377,405	401,768	415,040	514,158	511,845	392,407	364,417	350,744	336,849
2025	292,208	285,606	324,814	374,024	400,026	414,942	515,712	515,055	397,275	369,048	355,505	341,653

Source: JLARC staff models of economic and traffic data.

Figure 2
Traffic Projection Performance
Monthly Vehicle Counts for All Classes



defined in the Highway Capacity Manual 2000 were calculated using the number of hours with traffic volumes exceeding each service level threshold. The service levels from the Highway Capacity Manual are shown in Table 3. The calculation of base levels, and the resulting monthly threshold for evaluation of traffic volumes in future months are shown in Table 4. Based on the peak traffic in the month of July, the base level of traffic for evaluating future increases in traffic volume was 333,000 vehicles per month.

Table 3
Service Volumes for a Class I, Two-Lane Highway*

Free Flow Speed (mi/hr)	Service Volumes (vehicles/hour)				
	A	B	C	D	E
65	130	290	710	1390	2590
60	130	290	710	1390	2590
55		170	710	1390	2590
50			170	790	2590
45				170	2590

* Rolling terrain to accommodate 4 percent grades; 60/40 directional split; 14 percent trucks.

Source: Highway Capacity Manual 2000.

Table 4
Current Peak Monthly Traffic Hours by Service Level
55 mph Free-Flow Speed

Service Level	pc/hr	Hours/Wk	pc/Wk	Percent pc	pc/Mth
A-B	355*	117	41,535	49.9	166,140
C	710	43	30,530	36.7	122,120
D	1390	8	11,120	13.4	44,480
E	2590	0	0	0.0	0
		168	83,185	100.0	332,740

* Average non-peak flow.
pc = passenger cars.

Source: JLARC staff analysis of July 2001 hourly traffic and Highway Capacity Manual 2000 service volumes.

Using the monthly traffic volume criterion of 333,000 vehicles, JLARC staff then evaluated the projections of monthly traffic in five-year increments to determine when the current level of traffic in the peak summer month could be experienced in six or more months per year. Table 5 shows that the threshold is exceeded six or more months in the year 2020, when traffic in eight months is projected to surpass 333,000 vehicles.

The analysis also examined how the projected increase in traffic would likely affect the peak periods of each week. Table 6 shows the projection of hourly traffic for the second week in July for 2015, 2020, and 2025. These projections use the monthly traffic estimates and distribute the volume according to existing patterns of daily and hourly traffic. In other words, the increases in traffic over time

from the JLARC staff models are distributed according to the proportion of traffic in each hour of each day per week. This likely understates the volume of traffic in peak periods, and overstates the volume of traffic during periods with historically low volumes, such as the hours just after midnight. Peak traffic volume occurs from about 10:00 a.m. through 12:00 noon on weekend days. Currently, about eight hours of peak traffic occurs in each week of July and August. By 2020, this is projected to expand to 20 hours over three days, between 10:00 a.m. and 3:00 p.m. Also in 2020, for two hours the volume is in excess of 2,400 vehicles per hour, which approaches the 2,590 vehicle capacity of the two-lane tunnels. Additional traffic growth expands the peak periods in 2025 to 23 hours each week over the three weekend days.

Table 5
Projected Monthly Traffic for the Chesapeake Bay Bridge-Tunnel

Month	Actual 2001	Estimated Traffic Count in Each Month				
		2005	2010	2015	2020	2025
January	168,622	218,869	242,207	250,680	278,047	292,208
February	169,054	212,269	235,651	244,136	271,566	285,606
March	199,509	251,496	274,919	283,417	310,909	324,814
April	260,991	300,711	324,178	332,690	360,243	374,024
May	274,632	326,716	350,226	358,751	386,366	400,026
June	304,646	341,634	365,184	373,723	401,400	414,942
July	394,554	442,394	465,992	474,545	502,283	515,712
August	390,561	441,731	465,370	473,938	501,736	515,055
September	273,471	323,936	347,622	356,205	384,064	397,275
October	248,321	295,539	319,269	327,869	355,787	369,048
November	258,321	281,881	305,656	314,274	342,250	355,505
December	236,573	267,892	291,712	300,348	328,383	341,653

Note: = Traffic in excess of 333,000 vehicles per month; = Traffic in excess of 400,000 vehicles per month; = Traffic in excess of 500,000 vehicles per month.

Source: JLARC staff analysis of CBBT monthly traffic.

Evaluation of Secondary Need Factors

Three secondary need factors were considered as a part of the analysis: (1) safety of vehicular traffic in the tunnels and approaches, (2) enhancement of the tunnel maintenance program, and (3) accommodation of a deeper channel for the port of Hampton Roads (Thimble Shoal Channel). The premise was that significant findings in any one of these three secondary need factors might be justification for advancing construction of the tunnels to an earlier date.

Analysis of Accident Data. To evaluate the safety of the tunnels. JLARC staff reviewed the circumstances related to the reportable accidents in the tunnels and the tunnel approaches since the opening of the parallel bridges. For the period from April 1999 through August 2002, there were 88 reportable accidents recorded in the director's monthly reports to the commission. Of those, 19 were reported to be in the

tunnels or tunnel approaches where traffic merges from four lanes to two. Of the 19 accidents in the tunnels or approaches, only three appeared to occur as the result of either opposing traffic or congestion in the tunnels due to inadequate capacity. In two instances, the side mirrors of trucks struck each other, causing damage to the vehicles involved. In the third accident a truck crashed into the rear of slow traffic due to congestion on the July 4, 2002, holiday weekend. All 19 of the accidents are listed in Table 7, and the three considered the result of the tunnel design or capacity are highlighted. The relative low number of accidents in the tunnels which were the result of opposing traffic or inadequate capacity for traffic did not appear to justify an acceleration of the construction of parallel tunnels.

Table 7
Recent Accidents In or Approaching the CBBT Tunnels

Date	Tunnel	Cause
7/17/99	Thimble Shoal	Tire blow-out caused truck and boat trailer to hit tunnel wall
8/29/99	Thimble Shoal	DUI driver attempted to pass in tunnel and hit tunnel wall
12/16/99	Chesapeake	Driver fell asleep and crossed lane, hitting opposing vehicle
4/25/00	Chesapeake	Truck jackknifed trying to stop for work detail in tunnel
6/20/00	Chesapeake	Truck drifted into tunnel wall
7/22/00	Chesapeake	Driver fell asleep and hit arrow board for tunnel merge area
8/14/00	Thimble Shoal	Driver of car lost control due to wet pavement from rain
8/25/00	Chesapeake	Driver of van lost control due to wet pavement from rain
9/07/00	Thimble Shoal	Truck rear-ended by another truck
4/26/01	Chesapeake	Truck hit tunnel ceiling
5/22/01	Thimble Shoal	Two trucks struck mirrors
6/16/01	Chesapeake	Drivers of two vehicles lost control due to wet pavement, hit wall
8/28/01	Thimble Shoal	Truck hit from behind while waiting for car to turn on to island #1
12/14/01	Chesapeake	Three vehicles hit debris in tunnel roadway
5/7/02	Chesapeake	Truck rear-ended waiting for work detail in tunnel
6/23/02	Thimble Shoal	Truck hit overhead light fixtures
7/06/02	Thimble Shoal	Rear end collision due to slow traffic in tunnel
8/11/02	Thimble Shoal	Car struck curb while turning on to island #1
8/13/02	Chesapeake	Two trucks struck mirrors

Source: JLARC staff review of Director's Monthly Reports.

Analysis of Tunnel Maintenance. A second concern related to the ability of the district to perform ordinary maintenance in the tunnels. On the bridges, a lane can be closed for maintenance without the need for flagmen to alternate traffic. Trucks with crash cushions protect maintenance staff while work is underway. Because the tunnels have two lanes with opposing traffic, maintenance work in one lane requires that police or emergency crew members stop and alternate traffic in the remaining lane. In interviews with JLARC staff, CBBT maintenance personnel reported that the requirement for lane closures severely limits the ability to complete required maintenance tasks in the tunnels. For example, due to concerns about rear-end collisions, lane closures are not made when the bridge pavement is wet due to rainy weather. Parallel tunnels with two lanes of traffic in each direction would provide maintenance personnel with greater flexibility in completing work in the tunnels.

However, even under current conditions, maintenance staff indicated that work can proceed in the tunnels when necessary, with some inconvenience to the traveling public. At no time did any maintenance staff indicate that the restrictions related to lane closures were making it impossible to do necessary work. The limitations on maintenance do not appear, then, to be a sufficient justification for advancing the construction of the parallel tunnels prior to the year 2020.

Analysis of an Increased Channel Depth. One final consideration in determining when the parallel tunnels should be constructed is the proposal by the Virginia Port Authority (VPA) to increase the depth of the Thimble Shoal Channel from 50 feet to 65 feet below mean low water. Because the top of the existing tunnel structure is at 63 feet, with an additional 10 feet of protective cover, the CBBT is a significant barrier to a deeper channel. In a study released in August 2002, the VPA recommended that the channel be deepened to the authorized 55 feet. This would require that five feet of protective cover be removed from the portion of the Thimble Shoal Channel directly below the shipping channel. The U.S. Army Corps of Engineers has recommended that a layer of armor rock be used to cover the tunnel to protect it from ships running aground or sinking on the tunnel. With this modification, the VPA report concludes that the channel "could effectively accommodate all of the container vessels likely to serve the Atlantic Coast container trades over the next 10 to 20 years." With regard to the dry bulk fleet, such as ships transporting grain or coal, the report states that a 55 foot channel "can accommodate approximately 70% of the world's dry bulk fleet capacity...."

Therefore, construction of the parallel tunnel with a design consistent with a 65 foot channel in the 2015 to 2020 time frame appears to be within the requirements of the VPA. Of course, the existing Thimble Shoal Tunnel would remain an obstacle, and either replacement or modification (such as demolition and replacement of the central portion under the channel) might be necessary. Thus, there appears to be no urgent need to advance construction of the tunnels in order to accommodate the VPA's desire to deepen the channel.

Projection of Estimated Engineering and Construction Costs

The costs for engineering and construction of the parallel tunnels used in the JLARC staff analysis were based on a preliminary estimate prepared by CBBT district staff in 2000. That estimate was based on construction of a single two-lane tunnel in the existing alignment for the parallel bridges. CBBT developed the initial projection based on estimated quantities for construction of the structures, and applied unit costs from contracts for the Monitor-Merrimac Memorial Bridge-Tunnel and the CBBT Parallel Crossing Project. A 15 percent contingency was added to the costs. Engineering costs were estimated at five percent of construction costs. The total costs of the parallel tunnel project was estimated to be \$468 million, in 2000 dollars. The total consists of \$11 million for engineering and \$457 for construction.

To use the CBBT estimates for the JLARC study, the costs needed to be escalated from 2000 dollars to dollars in future years through 2025. For this analysis, the escalation of engineering and construction costs over time was assumed to be at a constant rate. JLARC staff used the Bureau of Labor Statistics producer price index for highway and street construction (Series ID: PCUBHWY#) to calculate the

Table 8
Estimated Costs of Parallel Tunnels

Year	Increase	Engineering	Construction
2000		\$11,000,000	\$457,000,000
2001	0.004	\$11,044,000	\$458,828,000
2002	0.022	\$11,286,968	\$468,922,216
2003	0.022	\$11,535,281	\$479,238,505
2004	0.022	\$11,789,057	\$489,781,752
2005	0.022	\$12,048,417	\$500,556,950
2006	0.022	\$12,313,482	\$511,569,203
2007	0.022	\$12,584,379	\$522,823,726
2008	0.022	\$12,861,235	\$534,325,848
2009	0.022	\$13,144,182	\$546,081,016
2010	0.022	\$13,433,354	\$558,094,799
2011	0.022	\$13,728,888	\$570,372,884
2012	0.022	\$14,030,923	\$582,921,088
2013	0.022	\$14,339,604	\$595,745,352
2014	0.022	\$14,655,075	\$608,851,749
2015	0.022	\$14,977,487	\$622,246,488
2016	0.022	\$15,306,991	\$635,935,911
2017	0.022	\$15,643,745	\$649,926,501
2018	0.022	\$15,987,907	\$664,224,884
2019	0.022	\$16,339,641	\$678,837,831
2020	0.022	\$16,699,114	\$693,772,263
2021	0.022	\$17,066,494	\$709,035,253
2022	0.022	\$17,441,957	\$724,634,029
2023	0.022	\$17,825,680	\$740,575,977
2024	0.022	\$18,217,845	\$756,868,649
2025	0.022	\$18,618,638	\$773,519,759

Source: JLARC staff projection of costs from CBBT estimates and Bureau of Labor Statistics Producer Price Indexes.

mean inflation since 1987. The mean increase was then used to inflate the costs in each year of the JLARC projections. Table 8 shows the data for each year of the projection of engineering and construction costs.

Projection of Estimated Cash Balances and Bonding Capacity

Funding for the costs of construction was assumed to be available from two sources: (1) CBBT cash balances, and (2) CBBT-issued revenue bonds. The projection of cash balances was based on estimated toll and other revenues through 2025, net of operating, reserve maintenance, debt service, and other expenses. The projected revenue and individual expense items for each of the 23 years is shown in Attachment B, beginning on page 25.

Projection of Cash Balances. As shown in Attachment B, toll revenues were estimated by vehicle class from the JLARC staff traffic projections discussed earlier in this technical appendix. Revenue was calculated by multiplying the appropriate toll rate for each vehicle class by the projected vehicle count for the class. Other revenues were calculated by increasing the FY 2002 amount of other revenues by the prior five-year mean of growth, or 6.73 percent annually. Urban street payments

were projected by increasing the FY 2003 amount reported to the CBBT by VDOT, by the five-year mean of growth in the VDOT maintenance cost index, or 2.96 percent annually. Interest income was projected by CBBT staff based on the current estimated return on U.S. government securities, or 2.0 percent for principal and 1.7 percent for interest.

Operating costs were projected using the mean growth for the prior 12-year period, or 4.39 percent annually. Insurance costs were drawn from the CBBT six-year maintenance program, and held constant over the 23 years of the projection. Debt service costs were from the CBBT bond Official Statement schedules for the outstanding issues. Finally, projections of the costs for reserve maintenance projects were from the CBBT six-year maintenance plan through 2008, and increased using the VDOT five-year mean maintenance cost index for the period from 2009 through 2025. Revenue, expense, and other amounts shown in Attachment B have been rounded. Table 9 shows the net revenue amounts used to estimate the accumulation of general fund balances, which was \$64.2 million in FY 2002.

Projection of Bonding Capacity. The projections of CBBT bonding capacity were calculated by CBBT financial staff using: (1) the JLARC projected stream of toll revenue to determine the cash flow available for debt service, (2) a 30-year term for the debt service, (3) a 120 percent toll rate covenant, and (4) a yield of 5.14 percent (from Bloomberg, as of October 22, 2002, for 30 year revenue bonds.) A present value calculation was used to determine the bonding capacity given the available funds for debt service and the assumed yield and term. The present value function as implemented in Microsoft Excel is:

$$pv*(1+rate)^{nper} + pmt(1+rate*type) * \left[\frac{(1+rate)^{nper} - 1}{rate} \right] + fv = 0$$

where:

rate is the yield per period;

nper is the total number of payment periods;

pmt is the amount of debt service paid each period;

fv is the future value, or balance at the end of all payments; and

type is either 0 or 1, indicating whether payments are due at the end of the period or the beginning.

The *fv* and *type* parameters are not specified in the CBBT bond capacity calculations, and so are assumed to be 0. As shown in Table 10, the total bonding capacity was reduced by the amount of outstanding principal for existing CBBT bond issues.

Evaluation of Costs and Available Funding

The evaluation of costs and available funding consisted of a comparison of tunnel construction costs and CBBT cash and available bonding capacity at five year intervals. Table 10 shows the comparison given the revenues estimated from the existing toll structure beginning in 2010. The status of available funding for the year 2014 is also shown since that is the year construction would need to begin for completion in 2020.

Table 9
Chesapeake Bay Bridge-Tunnel
Projected Revenues, Expenses, and Net Income
(In \$Millions)

FY	Revenues				Expenses				Net Revenue
	Tolls	Urban Street Payments	Other	Total Revenues	Operations	Maintenance Reserve	Debt Service	Total Expenses	
2003	\$38.7	\$1.0	\$4.6	\$44.3	\$9.8	\$9.5	\$22.4	\$41.7	\$2.6
2004	39.2	1.0	4.5	44.8	10.2	9.4	22.4	42.1	2.7
2005	39.8	1.1	4.7	45.5	10.7	7.3	22.4	40.4	5.1
2006	40.3	1.1	5.0	46.4	11.1	5.8	22.4	39.4	7.0
2007	40.8	1.1	5.3	47.3	11.6	5.8	22.4	39.9	7.5
2008	41.4	1.2	5.7	48.2	12.1	5.8	22.4	40.4	7.9
2009	42.0	1.2	6.1	49.2	12.7	6.0	22.4	41.0	8.2
2010	42.6	1.2	6.5	50.3	13.2	6.1	16.3	35.6	14.7
2011	43.2	1.3	7.2	51.6	13.8	6.3	6.3	26.4	25.2
2012	43.4	1.3	8.2	52.9	14.4	6.5	6.3	27.2	25.6
2013	42.3	1.3	9.2	52.8	15.0	6.7	6.2	27.9	24.9
2014	42.7	1.4	10.2	54.2	15.7	6.8	6.5	29.0	25.2
2015	43.2	1.4	11.2	55.9	16.4	7.0	6.5	29.9	26.0
2016	43.8	1.5	12.3	57.6	17.1	7.2	6.5	30.8	26.8
2017	44.5	1.5	13.4	59.3	17.9	7.4	11.1	36.4	22.9
2018	45.1	1.5	14.3	61.0	18.7	7.6	17.0	43.3	17.6
2019	45.8	1.6	15.1	62.5	19.5	7.8	17.0	44.4	18.1
2020	46.5	1.6	15.9	64.0	20.3	8.1	17.0	45.4	18.6
2021	47.2	1.7	16.8	65.7	21.2	8.3	17.0	46.5	19.1
2022	47.9	1.7	17.7	67.3	22.1	8.5	17.0	47.7	19.6
2023	48.6	1.8	18.6	69.0	23.1	8.8	16.5	48.3	20.7
2024	48.9	1.8	19.6	70.4	24.1	9.0	16.5	49.6	20.8
2025	47.9	1.9	20.6	70.4	25.2	9.3	16.5	50.9	19.5
Total	\$1,005.7	\$32.3	\$252.6	\$1,290.6	\$376.1	\$171.1	\$357.0	\$904.2	\$386.4

Source: JLARC staff estimates of revenues and expenses.

Table 10
Funding Available for Construction of Parallel Tunnels
(In \$Millions, Current Toll Rates)

Year	General Fund Balance	Total Debt Capacity	Principal Outstanding	Debt Capacity Available	Total Funds Available	Tunnel Construction Costs	Funding (Shortage)/ Excess
2002	\$ 64.2	\$315	\$218.7	\$ 96.3	\$160.5	\$468.9	\$(308.4)
2010	119.9	390	114.9	275.1	395.0	558.1	(163.1)
2014	220.8	399	113.7	285.3	506.1	608.8	(102.7)
2015	246.8	409	113.2	295.8	542.6	622.2	(79.6)
2020	350.8	449	71.5	377.5	728.3	693.8	34.5
2025	450.5	453	0	453.0	903.5	773.5	130.0

Source: JLARC staff analysis of CBBT financial and other data.

To evaluate the impact on funding of modifications to the toll structure, JLARC staff: (1) used the traffic models to estimate the price elasticity of CBBT traffic based on the performance of traffic subsequent to the 1991 general toll increase, and (2) recalculated toll revenues with revised traffic counts and potential changes to the toll rates for each vehicle class. The elasticity tests for the 1991 toll increase indicated about a 1,000 vehicle decrease in passenger cars for every one percent increase in the toll. After accounting for the impact of inflation since 1991, a one percent increase in the current toll was estimated to result in a reduction of 960 vehicles. Therefore, a \$1.00 increase in the toll rate for passenger cars could be expected to initially reduce traffic volume by about 9,600 passenger cars per month. A similar analysis for heavy trucks did not produce a statistically significant reduction in the 1991 traffic counts, so no reduction was assumed in the projections for potential toll rate changes through 2025 (though some minimal reduction could be expected initially).

JLARC staff developed a toll revenue simulator which recalculates CBBT toll revenues given a set of toll rates, and after accounting for the reductions in traffic due to the price increase. Revised toll revenue estimates are calculated for each fiscal year from 2004 through 2025. The toll revenue simulator was used to evaluate the impact of various modifications to the general toll rate schedule, as well as the rates for selected vehicle classes. For example, a \$1 general rate increase across all vehicle classes (but retaining the 24-hour discount) is estimated to produce an additional \$60 million in revenues through 2025. The \$1 increase in combination with discontinuance of the 24-hour discount produces an estimated \$120 million. A \$2 increase with the discount is projected to provide about \$115 million through 2025. The impact of these additional revenues on funding available for construction of the parallel tunnels is shown in Table 11, on the next page.

Table 11
Alternatives to Fund Tunnel Construction from Increased Tolls
(In \$Millions)

Alternative 1: \$1 General Toll Increase for All Vehicle Classes

Year	General Fund Balance	Total Debt Capacity	Principal Outstanding	Debt Capacity Available	Total Funds Available	Tunnel Construction Costs	Funding (Shortage)/ Excess
2002	\$ 64.2	\$315	\$218.7	\$ 96.3	\$160.5	\$468.9	\$(308.4)
2010	136.9	423	114.9	308.1	445.0	558.1	(113.1)
2014	248.4	433	113.7	319.3	567.7	608.8	(41.1)
2015	277.1	443	113.2	329.8	606.9	622.2	(15.3)
2020	395.6	488	71.5	416.5	812.1	693.8	118.3
2025	511.3	494	0	494.0	1,005.3	773.5	231.8

**Alternative 2: \$1 General Toll Increase for All Vehicle Classes
and Discontinue the 24-Hour Return Trip Discount**

Year	General Fund Balance	Total Debt Capacity	Principal Outstanding	Debt Capacity Available	Total Funds Available	Tunnel Construction Costs	Funding (Shortage)/ Excess
2002	\$ 64.2	\$315	\$218.7	\$ 96.3	\$ 160.5	\$468.9	\$(308.4)
2010	154.7	456	114.9	341.1	495.8	558.1	(62.3)
2014	277.0	467	113.7	353.3	630.3	608.8	21.5
2015	308.5	478	113.2	364.8	673.3	622.2	51.1
2020	441.4	525	71.5	453.5	894.9	693.8	201.1
2025	572.7	533	0	533.0	1,105.7	773.5	332.2

Alternative 3: \$2 General Toll Increase for All Vehicle Classes

Year	General Fund Balance	Total Debt Capacity	Principal Outstanding	Debt Capacity Available	Total Funds Available	Tunnel Construction Costs	Funding (Shortage)/ Excess
2002	\$ 64.2	\$315	\$218.7	\$ 96.3	\$ 160.5	\$468.9	\$(308.4)
2010	152.3	453	114.9	338.1	490.4	558.1	(67.7)
2014	273.6	463	113.7	349.3	622.9	608.8	14.1
2015	305.0	474	113.2	360.8	665.8	622.2	43.6
2020	436.6	523	71.5	451.5	888.1	693.8	194.3
2025	567.1	531	0	531.0	1,098.1	773.5	324.6

Source: JLARC staff analysis of CBBT revenues and tunnel construction costs.

Attachment A

Regression Model Summaries for Traffic Projections

Dependent Variable: CARS_02 Method: Least Squares Date: 08/30/02 Time: 13:19 Sample: 1990:01 2000:06 Included observations: 126				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	85786.28	73690.70	1.164140	0.2470
GAS	-5.504341	103.5101	-0.053177	0.9577
CARS_02(-1)	-0.229657	0.093479	-2.456779	0.0156
CARS_02(-12)	0.067685	0.096354	0.702456	0.4839
US_REAL_PI	14.20536	10.85672	1.308439	0.1936
US_EMP	-2.761059	2.067643	-1.335365	0.1846
VA_CES	60.68363	62.18933	0.975789	0.3314
REGION_EMP	0.135805	0.109836	1.236437	0.2190
REGION_POP	0.018327	0.067352	0.272105	0.7861
D_FEB	-14185.79	5694.540	-2.491122	0.0143
D_MAR	12546.22	6882.924	1.822804	0.0712
D_APR	57519.68	8366.713	6.874823	0.0000
D_MAY	84771.58	10691.95	7.928546	0.0000
D_JUN	97807.82	12810.84	7.634772	0.0000
D_JUL	178985.0	19460.95	9.197136	0.0000
D_AUG	200404.3	22828.41	8.778725	0.0000
D_SEP	109143.4	16994.05	6.422447	0.0000
D_OCT	63879.14	9465.367	6.748723	0.0000
D_NOV	50756.78	8591.647	5.907689	0.0000
D_DEC	38748.76	7761.826	4.992221	0.0000
R-squared	0.981849	Mean dependent var	195856.2	
Adjusted R-squared	0.978596	S.D. dependent var	59580.70	
S.E. of regression	8716.754	Akaike info criterion	21.12850	
Sum squared resid	8.05E+09	Schwarz criterion	21.57870	
Log likelihood	-1311.095	F-statistic	301.7886	
Durbin-Watson stat	2.015255	Prob(F-statistic)	0.000000	

Dependent Variable: CARS_3				
Method: Least Squares				
Date: 09/11/02 Time: 14:22				
Sample(adjusted): 1975:02 2000:06				
Included observations: 305 after adjusting endpoints				
Convergence achieved after 5 iterations				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	261.0989	223.9037	1.166121	0.2445
REGION_EMP	0.000117	0.000346	0.338125	0.7355
CARS_3(-12)	0.530506	0.052211	10.16072	0.0000
D_FEB	-49.18254	92.18553	-0.533517	0.5941
D_MAR	134.7236	106.7961	1.261503	0.2081
D_APR	670.5787	132.0483	5.078285	0.0000
D_MAY	1366.652	185.9390	7.350001	0.0000
D_JUN	1757.752	223.2818	7.872346	0.0000
D_JUL	2659.313	311.7562	8.530104	0.0000
D_AUG	2257.070	276.4216	8.165317	0.0000
D_SEP	921.8877	152.4884	6.045626	0.0000
D_OCT	561.6309	125.5222	4.474357	0.0000
D_NOV	219.2664	109.6287	2.000081	0.0464
D_DEC	76.39071	93.45334	0.817421	0.4144
AR(1)	0.324454	0.056268	5.766207	0.0000
R-squared	0.963661	Mean dependent var	2554.259	
Adjusted R-squared	0.961907	S.D. dependent var	1941.694	
S.E. of regression	378.9704	Akaike info criterion	14.76072	
Sum squared resid	41649386	Schwarz criterion	14.94369	
Log likelihood	-2236.010	F-statistic	549.3140	
Durbin-Watson stat	2.073694	Prob(F-statistic)	0.000000	
Inverted AR Roots	.32			

Dependent Variable: TRUCK_2				
Method: Least Squares				
Date: 08/30/02 Time: 14:41				
Sample: 1990:01 2000:06				
Included observations: 126				
Convergence achieved after 305 iterations				
Backcast: 1989:12				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4653.450	903.1587	-5.152417	0.0000
TREND	-6.416686	2.519434	-2.546876	0.0123
TRUCK_2(-1)	0.884303	0.036293	24.36569	0.0000
TRUCK_2(-12)	0.013105	0.034474	0.380150	0.7046
US_REAL_PI	0.278116	0.088067	3.157987	0.0021
REGION_EMP	-0.000979	0.000568	-1.723506	0.0877
REGION_POP	0.003271	0.000749	4.366085	0.0000
D_FEB	236.3908	151.4026	1.561338	0.1214
D_MAR	1127.976	130.8056	8.623301	0.0000
D_APR	1054.518	132.5227	7.957266	0.0000
D_MAY	949.5384	135.3423	7.015828	0.0000
D_JUN	821.5910	138.1637	5.946505	0.0000
D_JUL	1157.117	143.8349	8.044760	0.0000
D_AUG	448.3807	148.3381	3.022695	0.0031
D_SEP	-417.0012	145.4933	-2.866120	0.0050
D_OCT	301.0511	136.6329	2.203357	0.0297
D_NOV	-617.4822	135.7148	-4.549852	0.0000
D_DEC	-211.3354	157.4206	-1.342489	0.1823
MA(1)	-0.989781	1.143640	-0.865466	0.3887
R-squared	0.971021	Mean dependent var	5485.270	
Adjusted R-squared	0.966146	S.D. dependent var	1118.033	
S.E. of regression	205.7131	Akaike info criterion	13.62898	
Sum squared resid	4528013.	Schwarz criterion	14.05667	
Log likelihood	-839.6255	F-statistic	199.1827	
Durbin-Watson stat	1.782106	Prob(F-statistic)	0.000000	
Inverted MA Roots	.99			

Dependent Variable: TRUCK_3				
Method: Least Squares				
Date: 09/01/02 Time: 11:48				
Sample: 1990:01 2000:06				
Included observations: 126				
Convergence achieved after 82 iterations				
Backcast: 1989:12				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4649.141	8332.683	0.557940	0.5781
TREND	4.820877	10.43211	0.462119	0.6449
TRUCK_3(-1)	-0.059487	0.132436	-0.449178	0.6542
TRUCK_3(-12)	-0.250891	0.090203	-2.781408	0.0064
US_REAL_PI	-0.059851	0.359653	-0.166414	0.8681
REGION_EMP	-0.000373	0.004861	-0.076763	0.9390
REGION_POP	-0.002556	0.005567	-0.459045	0.6471
D_FEB	-52.77440	106.1195	-0.497311	0.6200
D_MAR	116.8401	148.8008	0.785212	0.4341
D_APR	310.0212	156.8188	1.976939	0.0506
D_MAY	462.8631	163.2664	2.835017	0.0055
D_JUN	837.6108	187.4475	4.468510	0.0000
D_JUL	1088.905	235.6932	4.620009	0.0000
D_AUG	1245.530	239.5769	5.198874	0.0000
D_SEP	951.4221	212.1570	4.484520	0.0000
D_OCT	921.9450	192.3650	4.792687	0.0000
D_NOV	346.8995	180.2212	1.924855	0.0569
D_DEC	99.30782	117.8222	0.842862	0.4012
MA(1)	0.689676	0.119482	5.772201	0.0000
R-squared	0.695972	Mean dependent var	1323.286	
Adjusted R-squared	0.644827	S.D. dependent var	458.3327	
S.E. of regression	273.1498	Akaike info criterion	14.19605	
Sum squared resid	7983359.	Schwarz criterion	14.62375	
Log likelihood	-875.3513	F-statistic	13.60783	
Durbin-Watson stat	1.907036	Prob(F-statistic)	0.000000	
Inverted MA Roots	-.69			

Dependent Variable: TRUCK_4				
Method: Least Squares				
Date: 09/01/02 Time: 10:56				
Sample: 1990:01 2000:06				
Included observations: 126				
Convergence achieved after 8 iterations				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-655.9806	668.8153	-0.980810	0.3289
TREND	-5.958593	2.498806	-2.384576	0.0188
TRUCK_4(-12)	-0.051088	0.094495	-0.540649	0.5899
VA_CES	1.118391	0.420165	2.661791	0.0089
D_FEB	-8.348630	44.24222	-0.188703	0.8507
D_MAR	268.5538	57.36290	4.681664	0.0000
D_APR	460.9330	67.12636	6.866646	0.0000
D_MAY	616.9135	80.96378	7.619622	0.0000
D_JUN	744.7104	94.50005	7.880529	0.0000
D_JUL	883.4294	98.77836	8.943552	0.0000
D_AUG	809.7912	94.21746	8.594916	0.0000
D_SEP	702.0332	87.66437	8.008194	0.0000
D_OCT	666.0771	83.68272	7.959554	0.0000
D_NOV	123.9336	61.90878	2.001875	0.0478
D_DEC	-76.08500	56.36216	-1.349930	0.1798
AR(1)	0.372057	0.088464	4.205719	0.0001
AR(3)	0.155592	0.088183	1.764428	0.0805
R-squared	0.901265	Mean dependent var	1617.563	
Adjusted R-squared	0.886772	S.D. dependent var	357.8809	
S.E. of regression	120.4246	Akaike info criterion	12.54483	
Sum squared resid	1580727.	Schwarz criterion	12.92750	
Log likelihood	-773.3244	F-statistic	62.18554	
Durbin-Watson stat	1.922934	Prob(F-statistic)	0.000000	
Inverted AR Roots	.69	-.16 -.44i	-.16+.44i	

Dependent Variable: TRUCK_5 Method: Least Squares Date: 08/30/02 Time: 13:56 Sample: 1990:01 2000:06 Included observations: 126 Convergence achieved after 11 iterations				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3932.553	4065.772	0.967234	0.3356
TREND	-18.76451	13.72927	-1.366753	0.1745
TRUCK_5(-12)	0.235226	0.102335	2.298592	0.0235
VA_CES	4.721955	2.293309	2.059013	0.0419
D_FEB	-264.6750	333.3430	-0.794002	0.4289
D_MAR	1625.354	406.9199	3.994286	0.0001
D_APR	1182.175	364.7976	3.240632	0.0016
D_MAY	2137.199	482.1632	4.432523	0.0000
D_JUN	4062.195	697.1018	5.827263	0.0000
D_JUL	3983.979	642.4600	6.201131	0.0000
D_AUG	2050.703	477.4546	4.295075	0.0000
D_SEP	1462.156	443.4355	3.297337	0.0013
D_OCT	1599.663	422.8140	3.783372	0.0003
D_NOV	136.4535	392.6178	0.347548	0.7289
D_DEC	-214.0451	380.1116	-0.563111	0.5745
AR(1)	0.154893	0.091735	1.688491	0.0942
AR(2)	0.005777	0.096996	0.059556	0.9526
AR(3)	0.269292	0.094851	2.839107	0.0054
R-squared	0.880104	Mean dependent var	19773.01	
Adjusted R-squared	0.861231	S.D. dependent var	2119.170	
S.E. of regression	789.4264	Akaike info criterion	16.31205	
Sum squared resid	67304963	Schwarz criterion	16.71724	
Log likelihood	-1009.659	F-statistic	46.63408	
Durbin-Watson stat	1.911972	Prob(F-statistic)	0.000000	
Inverted AR Roots	.70	-.28+.55i	-.28 -.55i	

Dependent Variable: BUS_3 Method: Least Squares Date: 09/01/02 Time: 12:34 Sample: 1990:01 2000:06 Included observations: 126 Convergence achieved after 6 iterations				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9463.538	1359.330	6.961915	0.0000
TREND	9.263946	1.566892	5.912306	0.0000
US_EMP	-0.047594	0.013273	-3.585877	0.0005
REGION_POP	-0.005310	0.000761	-6.977835	0.0000
VA_CES	0.920470	0.315005	2.922075	0.0042
D_FEB	19.08666	23.68641	0.805806	0.4221
D_MAR	173.8416	28.35284	6.131364	0.0000
D_APR	479.0431	32.14187	14.90402	0.0000
D_MAY	542.9175	34.42296	15.77196	0.0000
D_JUN	321.3738	39.64816	8.105643	0.0000
D_JUL	485.1400	30.15416	16.08866	0.0000
D_AUG	510.7942	30.22680	16.89872	0.0000
D_SEP	362.2613	34.77005	10.41878	0.0000
D_OCT	319.4430	36.89184	8.658907	0.0000
D_NOV	270.2857	37.69249	7.170808	0.0000
D_DEC	96.70452	37.52274	2.577224	0.0113
AR(1)	0.178413	0.094839	1.881223	0.0627
AR(2)	-0.028121	0.096328	-0.291934	0.7709
AR(3)	-0.192380	0.097381	-1.975536	0.0508
R-squared	0.943305	Mean dependent var	789.4444	
Adjusted R-squared	0.933768	S.D. dependent var	226.7300	
S.E. of regression	58.35039	Akaike info criterion	11.10894	
Sum squared resid	364310.2	Schwarz criterion	11.53664	
Log likelihood	-680.8634	F-statistic	98.90539	
Durbin-Watson stat	1.986232	Prob(F-statistic)	0.000000	
Inverted AR Roots	.34+.51i	.34 -.51i	-.51	

Attachment B

Projected Revenue and Expenses

Projected Revenue and Expenses FY 2003 to FY 2025 Page 1 of 3

	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
Revenues							
Tolls ¹	38,730,406	39,240,086	39,763,792	40,298,942	40,845,874	41,405,113	41,977,040
Other ²	1,059,567	1,130,876	1,206,984	1,288,214	1,374,911	1,467,443	1,566,202
Urban Street Payments ³	999,415	1,028,998	1,059,456	1,090,816	1,123,104	1,156,348	1,190,576
Interest Income ⁴	3,511,000	3,389,000	3,464,000	3,707,000	3,947,000	4,214,000	4,492,000
Total	44,300,388	44,788,960	45,494,232	46,384,972	47,290,889	48,242,904	49,225,817
Expenses							
Operating ⁵	9,791,212	10,221,046	10,669,750	11,138,152	11,627,117	12,137,548	12,670,386
Insurance ⁶	460,000	475,000	475,000	475,000	475,000	475,000	475,000
Net Revenues from Operations	34,049,176	34,092,914	34,349,482	34,771,820	35,188,772	35,630,356	36,080,432
Debt Service							
Revenue Bonds ⁷	6,735,845	6,740,295	6,744,445	6,738,445	8,316,783	8,309,913	8,316,008
General Revenue Bonds ⁸	15,673,672	15,672,857	15,662,633	15,665,248	14,077,788	14,089,758	14,073,758
Reserve Maintenance Program⁹							
	9,035,697	8,973,000	6,805,000	5,365,000	5,340,000	5,345,000	5,503,212
Revenue over Total Expenditures¹⁰	2,603,962	2,706,762	5,137,404	7,003,127	7,454,201	7,885,685	8,187,454

Source: JLARC staff analysis of Chesapeake Bay Bridge-Tunnel District traffic and financial data.

Projected Revenue and Expenses
FY 2003 to FY 2025
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	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
Revenues								
Tolls ¹	42,562,071	43,160,429	43,358,366	42,309,679	42,657,949	43,217,811	43,826,247	44,458,632
Other ²	1,671,607	1,784,106	1,904,176	2,032,327	2,169,103	2,315,084	2,470,889	2,637,180
Urban Street Payments ³	1,225,817	1,262,101	1,299,459	1,337,923	1,377,526	1,418,301	1,460,282	1,503,507
Interest Income ⁴	4,827,000	5,414,000	6,289,000	7,153,000	8,030,000	8,911,000	9,821,000	10,722,000
Total	50,286,495	51,620,636	52,851,002	52,832,930	54,234,578	55,862,195	57,578,418	59,321,318
Expenses								
Operating ⁵	13,226,616	13,807,264	14,413,403	15,046,152	15,706,678	16,396,201	17,115,994	17,867,386
Insurance ⁶	475,000	475,000	475,000	475,000	475,000	475,000	475,000	475,000
Net Revenues from Operations	36,584,879	37,338,372	37,962,599	37,311,778	38,052,900	38,990,995	39,987,424	40,978,932
Debt Service								
Revenue Bonds ⁷	8,316,500	0	0	0	0	0	0	0
General Revenue Bonds ⁸	7,940,263	6,319,150	6,314,713	6,179,750	6,471,088	6,471,675	6,470,950	11,118,913
Reserve Maintenance Program⁹								
	5,666,107	5,833,824	6,006,505	6,184,298	6,367,353	6,555,826	6,749,879	6,949,675
Revenue over Total Expenditures¹⁰	14,662,009	25,185,398	25,641,380	24,947,731	25,214,460	25,963,493	26,766,595	22,910,344

Source: JLARC staff analysis of Chesapeake Bay Bridge-Tunnel District traffic and financial data.

**Projected Revenue and Expenses
FY 2003 to FY 2025
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	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025
Revenues								
Tolls ¹	45,109,248	45,776,708	46,460,884	47,162,046	47,880,530	48,616,828	48,936,437	47,935,386
Other ²	2,814,662	3,004,089	3,206,264	3,422,045	3,652,349	3,898,152	4,160,498	4,440,499
Urban Street Payments ³	1,548,010	1,593,831	1,641,009	1,689,583	1,739,594	1,791,086	1,844,103	1,898,688
Interest Income ⁴	11,482,000	12,099,000	12,734,000	13,386,000	14,056,000	14,735,000	15,439,000	16,129,000
Total	60,953,920	62,473,628	64,042,157	65,659,674	67,328,473	69,041,067	70,380,037	70,403,573
Expenses								
Operating ⁵	18,651,764	19,470,577	20,325,335	21,217,617	22,149,071	23,121,415	24,136,445	25,196,035
Insurance ⁶	475,000	475,000	475,000	475,000	475,000	475,000	475,000	475,000
Net Revenues from Operations	41,827,156	42,528,051	43,241,822	43,967,057	44,704,403	45,444,652	45,768,592	44,732,538
Debt Service								
Revenue Bonds ⁷	0	0	0	0	0	0	0	0
General Revenue Bonds ⁸	17,041,438	17,038,725	17,039,775	17,039,275	17,037,275	16,462,275	16,456,175	16,458,000
Reserve Maintenance Program⁹								
	7,155,386	7,367,185	7,585,254	7,809,777	8,040,947	8,278,959	8,524,016	8,776,327
Revenue over Total Expenditures¹⁰	17,630,332	18,122,141	18,616,793	19,118,005	19,626,181	20,703,418	20,788,401	19,498,212

Source: JLARC staff analysis of Chesapeake Bay Bridge-Tunnel District traffic and financial data.

Attachment B (continued)

Notes

¹Toll revenues based on JLARC staff models of traffic growth by vehicle class.

²Other revenues projected based on prior five year trend.

³Urban street payments projected based on VDOT maintenance cost index (MCI) five year average.

⁴Interest income projected based on estimated rate of return for U.S. government securities.

⁵Operating costs projected based on prior 12 year trend.

⁶Insurance estimate from CBBT six-year reserve maintenance program.

⁷Revenue bond debt service from 2001 Official Statement schedule.

⁸General revenue bond debt service from 2001 Official Statement schedule.

⁹Reserve maintenance from six-year plan through 2008 (less insurance), inflated thereafter by five-year average VDOT MCI.

¹⁰Total revenues minus operating expenses, insurance expense, gross debt service, and reserve maintenance expenditures.

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